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(54) IMPROVEMENTS IN OR RELATING TO ELECTRICAL SAFETY FUSES

(71) We, AKTIESELSKABET LAUR. KNUDSEN NORDISK ELECTRICITETS SELSKAB, of Haraldsgade 53, DK-2100 Copenhagen, Denmark, a Danish Corporation, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to electrical safety fuses. Such a fuse may have one or more fuse elements surrounded by an arc suppression material. The arc suppression material usually consists of quartz sand (SiO_2), but it is also possible to use other materials.

Attention is directed to our copending application No. 22659/77 (Serial No 1604819), from which the present application was divided and which describes and claims an electrical safety fuse.

According to the invention, there is provided an electrical safety fuse comprising at least one fuse element surrounded by arc suppression material, the or each fuse element comprising an electrically insulating substrate on a surface of which is provided one or more electrically conductive layers, the layer or layers being coated by a layer which substantially prevents oxidation of the layer or layers at normal working temperatures of the fuse.

Preferably, the electrically conductive layer or layers are arranged to define a break region of reduced cross-sectional area transverse to the direction of current flow.

Preferably, th electrically conductive layer or layers comprise a first layer on the surface of the substrate and a second layer substantially covering the first layer and divided transversely of the direction of current flow through the fuse element into at least two spaced apart regions.

Preferably, the material of the second layer has a higher conductivity than the material of the first layer.

The coating layer may fully cover the conductive layer or layers including at the break region.

Alternatively, the coating layer may cover the conductive layer or layers except at the break region.

The electrically insulating substrate may consist of two or more layers of different heat conductivity. The thermal time constant for the layer on which the electrically conducting —and thus heat generating—element is built up can be varied, and consequently it is possible to construct fuses with quite special fuse characteristics. By adapting the thickness of the various layers and their heat conductivity it is furthermore possible to achieve that the thermal time constant can be adapted to different combinations of current and time.

Preferably, a piece of material of substantially lower thermal conductivity than that of the substrate is disposed between the substrate and the first layer at the or each region which is not covered by the second layer.

Such a layer acts as a heat barrier during heavy overloads and the result of this will therefore be that the fuse will break in such cases. However, during a continuous high normal load, the heat will be conducted away through the layer, whose thickness and heat conductivity may be selected to provide desired characteristics.

The electrically conducting part of the fuse element may comprise several layers which can be selected individually on the basis of knowledge of exactly the specific properties of the materials which are desirable in the individual areas of the fuse element. Also here it is possible for each individual layer not to cover the entire extent of the element.

In the actual break region, one may for instance want to use metals or alloys which have a well-defined and reasonably high electrical conductivity, but of relatively low heat conductivity. Silver and aluminium and

respective alloys of each will then be suitable. In the areas between the break regions and in particular in the thicker and more material-consuming areas, more importance is attached to price, and therefore copper or aluminium may be used.

As the coating layer, which protects against oxidation at normal working temperatures of the fuse, aluminium and various ceramic materials may be used. The first and second layers maybe fully or partly covered by such a layer.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 shows in perspective a fuse element constituting a first embodiment of the invention; and

Fig. 2 shows in perspective a fuse element constituting a second embodiment of the invention.

Figure 1 shows a fuse element constituting a preferred embodiment of the invention comprising a substrate 18 comprising a heat conducting electrically insulating material, such as a ceramic material, upon which a layer of silver 19 is disposed. On each side of a break region 24, three layers of copper 20, 21 and 22 are disposed, which layers are protected against oxidation by a coating layer 23 made, for instance, of aluminium.

Figure 2 shows an embodiment comprising a substrate 40 upon which a thermally insulating layer 41 is disposed, on top of which is a material 42 with a relatively low electrical conductivity, e.g. a platinum-silver alloy with width-reducing holes 45. Layer parts 43 and 46 are disposed on each side of the break region and consist of a material of high electrical conductivity, e.g. copper. For the protection of these elements to prevent oxidation thereof at normal working temperatures of the fuse, a coating layer 44 is disposed on the top, which layer can for instance consist of aluminium or a ceramic material. The various conductive layers may be formed by vapour deposition, sputtering, silk screen printing (serigraphy) electroplating, chemical precipitation, or a combination thereof.

WHAT WE CLAIM IS:—

1. An electrical safety fuse comprising at least one fuse element surrounded by arc suppression material, the or each fuse element comprising an electrically insulating substrate on a surface of which is provided one or more electrically conductive layers, the layer or layers being coated by a layer which substantially prevents oxidation of the layer or layers at normal working temperatures of the fuse.

2. A safety fuse as claimed in claim 1, in which the electrically conductive layer or layers are arranged to define a break region of reduced cross-sectional area transverse to the direction of current flow.

3. A safety fuse as claimed in claim 2, in which the electrically conductive layer or layers comprise a first layer on the surface of the substrate and a second layer substantially covering the first layer and divided transversely of the direction of current flow through the fuse element into at least two spaced apart regions.

4. A safety fuse as claimed in claim 3, in which the material of the second layer has a higher conductivity than the material of the first layer.

5. A safety fuse as claimed in claim 3 or 4, in which the second layer comprises a plurality of superimposed sub-layers.

6. A safety fuse as claimed in any one of claims 3 to 5, in which the first layer has formed therein holes in the break region.

7. A safety fuse as claimed in any one of claims 2 to 6, in which a piece of material of substantially lower thermal conductivity than that of the substrate is disposed between the substrate and the break region.

8. A safety fuse as claimed in any one of claims 2 to 7, in which the coating layer fully covers the conductive layer or layers including at the break region.

9. A safety fuse as claimed in any one of claims 2 to 7, in which the coating layer covers the conductive layer or layers except at the break region.

10. A safety fuse as claimed in any one of the preceding claims, in which the substrate comprises a ceramic material.

11. A safety fuse as claimed in any one of the preceding claims, in which th substrate comprises a plurality of layers of different thermal conductivities.

12. A safety fuse as claimed in any one of the preceding claims, in which the coating layer comprises aluminium or a ceramic material.

13. An electrical safety fuse substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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1604820 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

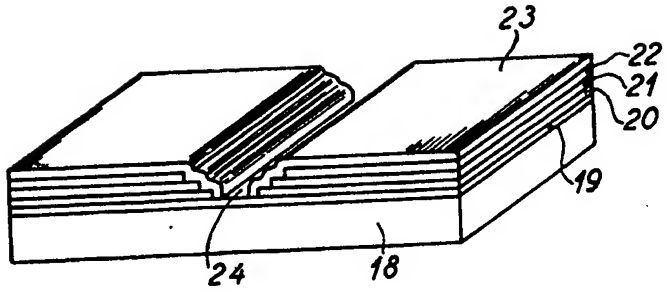

Fig. 1.

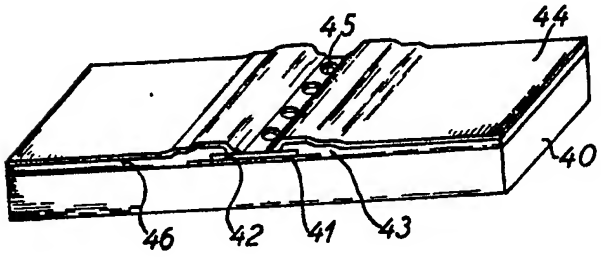

Fig. 2.